UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/172,389	10/14/1998	RONALD D. LARSON	10981013.1	9221

22879 7590 09/19/2005

HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400

EXAMINER	
NGUYEN, KIMBINH T	
ART UNIT	**PAPER NUMBER**
2671	

DATE MAILED: 09/19/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/172,389	LARSON, RONALD D.	
	Examiner	Art Unit	
	Kimbinh T. Nguyen	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 May 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-10 and 21-33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-10,21-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This action is responsive to amendment filed 05/27/05.

2. Claims 1, 4-10, 21-33 are pending in the application.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 4-10 and 21-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greene et al. (5,579,455) in view of Greene et al. (6,646,639).

Claim 1, Greene et al. (5,579,455) discloses a hierarchical tiler (hierarchical z-buffer visibility uses an octree spatial subdivision) configured to occlusion test primitives, the primitives comprising a maximum z value and a minimum z value (z-max elements, z-min elements; col. 11, lines 5-12), Greene et al. (5,579,455) does not teach the maximum and minimum z values associated with respective X-Y coordinate values; however, Greene et al. (6,646,639) teaches the maximum and the minimum z values (zfar and znear values) associated with x-y coordinates values (col. 21, line 28 through col. 22, line 20, figs 14 and 15), Greene (5,579,455) teaches the hierarchical tiler creates a z pyramid data as polygons defined by primitives are processed by the multi-function unit (col. 3, lines 61-64); Greene (6,646,639) teaches a parameter interpolator coupled to the hierarchical tiler configured to receive the X-Y coordinate values from the

hierarchical tiler and generate a z value at the pixel level for each received X-Y coordinate value (col. 25, line 33 through col. 28, line 44); a pixel-level comparator determines which values need to be written by a frame buffer controller; a memory unit stores a change in the z-pyramid data structure responsive to an occlusion test result for a visible primitive before the pixel level comparator determines which pixel level values need to be written by the frame buffer controller (abstract and col. 5, lines 4-12: near z-value are stored which are each representative of a near z-value on an object in a region. Thereafter, the stored near z-values are compared with far z-values computed for other objects in the region). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the zfar and znear associated with the x-y coordinate system taught by Greene (6,646,639) into the hierarchical z buffer visibility of Greene (5,579,455) for improving occlusion culling in graphic systems, because it would create a data structure adapted for use during conservative stencil culling (col. 5, lines 50-51).

Claim 4, Greene et al. (5,579,455) discloses the z pyramid data structure is periodically updated in accordance with pixel level values from a buffer responsive to the frame buffer controller (col. 5, line 50 through col. 6, line 36).

Claim 5, Greene et al. (5,579,455) discloses the pixel level comparison is performed responsive to the pixel level values from a z buffer responsive to the frame buffer controller (col. 5, line 50 through col. 6, line 46; col. 10, lines 8-27).

Claim 6, Greene et al. (6,646,639) discloses an object function unit coupled to the pixel level comparator and the z buffer configured to perform one function selected from clipping (figs. 21-26).

Claim 7, Greene et al. (6,646,639) discloses the hierarchical tiler maintains coverage masks to update the z pyramid (col. 4, lines 1-3; col. 34, lines 46-48).

Claim 8, Greene et al. (5,579,455) discloses the z pyramid comprises levels (four levels; fig. 5), each level comprising regions (2x2 region, 4x4 region), each region comprising subregions (display cells), each subregion comprising a z value (depth value), (see col. 10, lines 8-44; figs. 5 and 5A).

Claim 9, Greene et al. (5,579,455) discloses the hierarchical tiler compares the minimum z value with the z value of a region to determine if the primitive is occluded (col. 26, lines 61-67).

Claims 10 and 21, Greene et al. (5,579,455) discloses in response to a determination the visible primitive is not fully occluded, the hierarchical tiler determines whether any subregion is fully covered (the recursion proceeds until the farthest depth value in the z-max elements covered by a current z-max element); when the subregion is covered, the hierarchical tiler determines whether the z value of the subregion is to be replaced with the zmax value (col. 19, lines 44-49; fig. 12).

Claims 22 and 23, Greene et al. (5,579,455) discloses the hierarchical tiler maintains a coverage mask for each level of z pyramid; when the hierarchical tiler determines the zmax value is less than the z value for covered subregion, a bit in the coverage mask associated with the covered subregion is set (col. 17, lines 26-32).

Claims 24 and 26, Greene et al. (5,579,455) discloses in response to a determination that all the coverage mask bits have been set in the coverage mask associated with a first level of the z pyramid, a bit is set for the corresponding region in the coverage mask associated with the next level up in the z pyramid (col. 18, lines 9-19).

Claim 25, Greene et al. (5,579,455) discloses in response to a determination that all the bits in the coverage mask have been set for a particular region in the coverage mask, the hierarchical tiler replaces the zmax value with the zmax value of subregion (fig. 19A).

Claim 27, Greene et al. (5,579,455) discloses the hierarchical tiler maintains, for the Z pyramid data structure, coverage masks that are separate from the Z pyramid data structure (coarsest level and finest level) and that indicate which Z values in the Z pyramid data structure need to be updated (col. 19, lines 21-30).

Claim 28, Greene et al. (5,579,455) discloses the hierarchical tiler is configured to adjust the coverage mask associated with a particular level of the Z pyramid structure in response to a determination by the hierarchical tiler that the maximum Z value of the visible primitive is less than the Z value for a covered subregion at the particular level of the Z pyramid structure (col. 17, lines 26-32).

5. Claims 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greene et al. (5,579,455).

Claim 29, Greene et al. (5,579,455) discloses defining a Z pyramid data structure 9col. 5, lines 44-59); comparing a minimum Z value (the nearest z-value) of a primitive

to the Z pyramid data structure (col. 6, lines 25-27, lines 39-42); determining whether the primitive is occluded based on the comparing (the primitive is hidden in the quadrant; col. 6, lines 27-32); scan converting the primitive to a pixel level if the primitive is determined to be not fully occluded in the determining (the z-pyramid test: The bounding boxes of 715 cubes are scan converted to cull about 72 percent of the model polygons in the viewing frustum; col. 20, lines 11-51); and updating the Z pyramid based on the primitive prior to the scan converting (update depth buffer from z-max element; update depth buffer from z-min element. Note also that rather than scan converting the primitive in its entirely and subsequently writing color and depth values for the scan converted cell; col. 19, lines 13-37). This feature means updating the z-pyramid based on the primitive prior to the scan converting to accelerate scan conversion (see abstract and col. 2, lines 34-42). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to update the z-pyramid based on the primitive prior to the scanning, because it would implement z-buffer rendering (scan conversion method) with an initial set-up computation for each primitive followed by a scan conversion phase in which the affected pixels are incrementally updated. This already makes very good use of image space coherence, so the remaining challenge with z-buffer methods is to exploit object space and temporal coherence effectively (col. 2, lines 34-42).

Claim 30, Greene et al. (5,579,455) discloses the Z pyramid data structure comprises a maximum Z value for a group of pixels defining a region (z max value; col.

17, lines 27-32), and wherein the Z pyramid data structure comprises a Z value for a first subregion of the region (col. 5, lines 51-59), wherein the method further comprises: determining whether the first subregion of the region is fully covered by the primitive (the entire polygon is hidden; col. 6, lines 32-35); determining whether a maximum Z value of the primitive is less than the Z value for the first subregion (deciding whether the z max value in the covering depth elements provided to the routine is nearer than the nearest depth of the primitive; col. 17, lines 27-29; col. 19, lines 49-51); and changing the Z value for the first subregion to the maximum Z value of the primitive (update depth buffer from z-max) if the first subregion is fully covered by the primitive (z-max element covered by a current z-max element) and if the maximum Z value of the primitive is less than the Z value for the first subregion (col. 19, lines 44-67).

6. Claims 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greene et al. (5,579,455) in view of Greene et al. (6,646,639).

Claims 31, 32 and 33, Greene et al. (6,646,639) discloses the region has a plurality of subregions (col. 49, lines 29-30), and wherein the method further comprises: maintaining a coverage mask for the Z pyramid data structure (col. 4, lines 1-3; col. 34, lines 46-52), the coverage mask having a bit corresponding with each of the respective subregions (col. 59, lines 31-34); and setting the bit of the coverage mask corresponding to the first subregion if the Z value for the first subregion is changed to the maximum Z value (the far z-values) of the primitive (updating the far z-values and the coverage mask; col. 50, lines 35-67); updating the maximum z value for pixels in response to a determination that the coverage mask indicates that each of the z values

of subregions has been updated (col. 50, line 28 through col. 51, line 3). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate updating the z value and the coverage mask taught by Green, because it would process potentially visible samples on the polygon (col. 50, lines 15-19).

Response to Arguments

7. Applicant's arguments filed 05/27/05 have been fully considered but they are not persuasive.

With respect to the arguments of claim 1, Green et al. (6,646,69) teaches "Initially, near z-value are stored which are each representative of a near z-value on an object in a region. Thereafter, the stored near z-values are compared with far z-values computed for other objects in the region. Such comparison indicates whether an objects is visible in the region. Based on the comparison, z-values previously stored for image samples in the region are conditionally read from memory", col. 5, lines 4-12. It means storing a change (updating) in a z pyramid data structure from the results of a visible primitive test before performing the comparison to avoid reading z-values in a multi-pass rendering algorithm in a graphics pipeline. The Green et al. (5,579,455) teaches updating the Z pyramid based on the primitive prior to the scan converting (update depth buffer from z-max element; update depth buffer from z-min element. Note also that rather than scan converting the primitive in its entirely and subsequently writing color and depth values for the scan converted cell; col. 19, lines 13-37). This feature means updating the z-pyramid based on the primitive prior to the scan converting to

accelerate scan conversion (see abstract and col. 2, lines 34-42 as explained in the rejection of claim 29). The Green et al. (6,646,639) patent is a continuation-in-part of U.S. Patent Application 09/585,810, and this application is a continuation-in-part of the Patent Application 09/121,317 (Patent No. 6,480,205 having the same inventor and the title with the Patent 6,646,639 "Method and Apparatus for Occlusion Culling in Graphics Systems"; "modified Method and Apparatus for Improved Occlusion Culling in Graphics System") which disclosed the same subject matter: Z-buffer rendering, occlusion culling, Z-pyramid data structure and depth values. The Related U.S. Patents: (5,579,455), (6,480,205) and (6,646,639) could be combined together to establish a prima facial case of obviousness with respect to claim 1 and other claims of the application.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kimbinh T. Nguyen whose telephone number is (571) 272-7644. The examiner can normally be reached on Monday to Thursday from 7:00 AM to 4:30 PM. The examiner can also be reached on alternate Friday from 7:00 AM to 3:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached at (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

September 12, 2005

Kimbinh Nguyen

KIMBINH T. NGUYEN
PRIMARY EXAMINER